

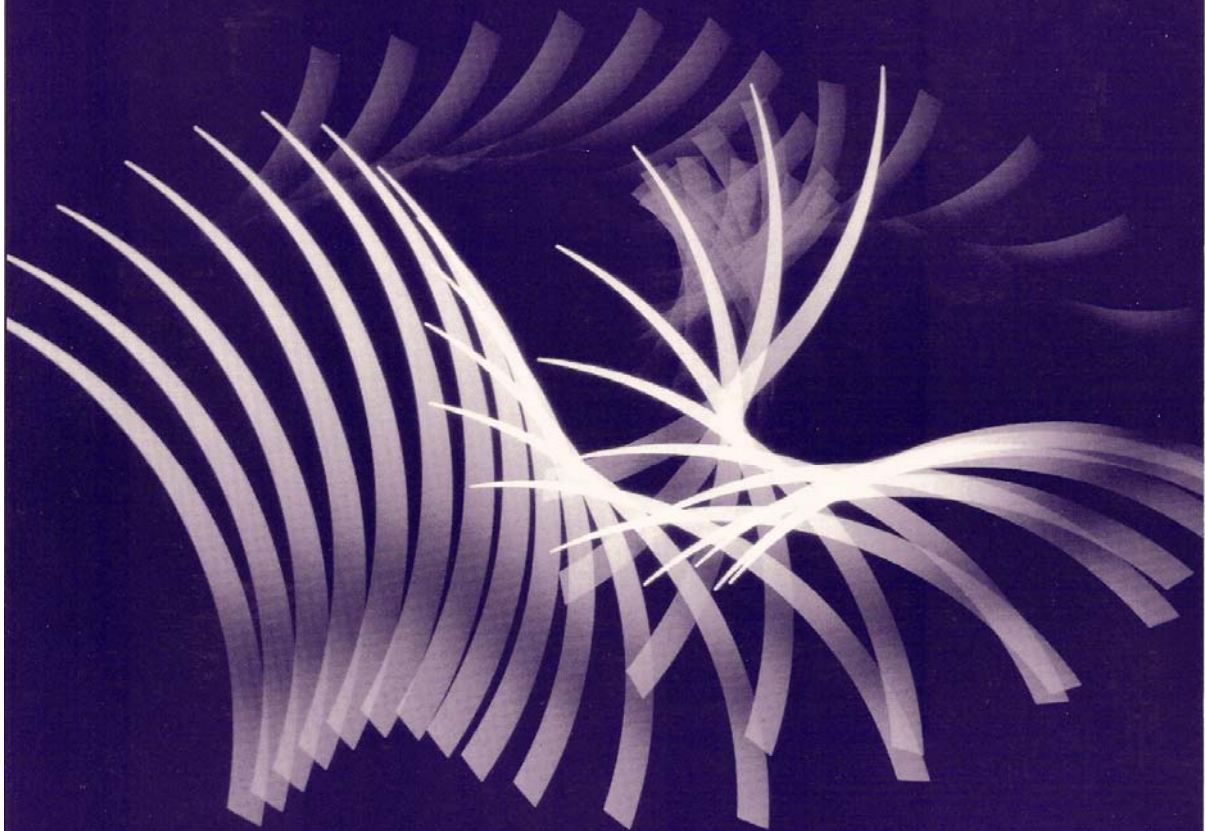
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## **Isokinetic assessment of the scapular muscles**

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The scapula plays an important role in normal shoulder function. In sports in which demands on the shoulder are extremely high, the quality of movements depends on the interaction between scapular and glenohumeral kinematics. Comparatively to a normal status, the scapular dyskinesis is defined as observable alteration in the position of the scapula and in the patterns of scapular motion in relation to the thoracic cage [1]. Surprisingly, only sparse literature focused on the isokinetic assessment of scapulothoracic muscles. To our knowledge, only Cools et al. [2,3] have investigated such evaluation, using a closed kinetic chain system.

The aim of this study was to provide new insights in the isokinetic assessment of the scapular muscle performances, among sedentary and overhead athletes populations. 10 sedentary men ( $23.5 \pm 2.6$  years;  $67.3 \pm 6.2$  kg) and 10 overhead athletes ( $22.2 \pm 2.3$  years;  $72.9 \pm 9.7$  kg) participated into the study. All subjects were free of previous shoulder pathology. The overhead population included 2 volleyball, 2 handball, 3 tennis and 3 badminton players, all with at least 9 years of intensive practice. They sustained a bilateral isokinetic assessment (Biodex 3 dynamometer) of the protractors (PRO) and retractors (RET) of the scapula (closed kinetic chain). Subjects were seated and the closed kinetic chain attachment was placed in a horizontal plane, at  $30^\circ$  from the frontal plane, which corresponded to the scapular plane; the elbow was placed in full extension. The range of motion was individualized from the maximal protraction to the maximal retraction positions.

After a specific warm up using an elastic theraband and familiarization on the isokinetic device, the isokinetic protocol consisted in 3 repetitions at slow speed (12.2 cm/s) and 5 repetitions at high speed (36.6 cm/s). The strength performances (peak-force in N) and ratios (Protractors / Retractors; PRO/RET) are described in Tables 1 and 2.

The maximum force developed by scapular muscles decreased with increase in motion velocity. Generally, there was no dominance effect, except for the RET at high speed within the sedentary population (Table 1). The PRO/RET ratios remained inferior to 1 indicating higher performances on RET muscle group (Table 2). Even if the athletes recruited in our study used their shoulder in an asymmetrical way, we did not find any significant difference between the dominant and non dominant ratios in that population; only the PRO/RET ratio of sedentaries at high speed showed a dominance effect. The PRO/RET ratios were higher into the athletes, yet the difference did not reach statistical significance. There was no significant difference between both populations, if considering the absolute strength or the bodyweight normalized peak force. The sports population appeared more homogenous with lower standard deviation values for all data. Nevertheless, in such closed kinetic chain assessment, compensations of the trunk during protraction and of the elbow during retraction must be strictly controlled.

The shoulder assessment in a closed kinetic chain allowed to investigate the force developed by the protractors and the retractors of the scapula. In spite of upper limb asymmetrical use through overhead activities, a dominance effect in strength performances or agonist-antagonist ratios was not detected among athletes recruited in that study. These preliminary results could be useful for further comparison with pathological cases.

**Table 1:** Peak force by body mass (N/kg) developed by the protractors (PRO) and retractors (RET) of the scapula at both velocities on the dominant (D) and non dominant (ND) shoulders.

	PRO 12.2 cm/s		PRO 36.6 cm/s		RET 12.2 cm/s		RET 36.6 cm/s	
	(N/kg)		(N/kg)		(N/kg)		(N/kg)	
	(means $\pm$ SD)		(means $\pm$ SD)		(means $\pm$ SD)		(means $\pm$ SD)	
	D	ND	D	ND	D	ND	D	ND
<b>Sedentaries</b>	3.57	3.40	2.42	2.41	4.46	4.32	3.59	2.99
	$\pm 1.19$	$\pm 1.22$	$\pm 0.94$	$\pm 1.01$	$\pm 1.57$	$\pm 1.84$	$\pm 1.47$	$\pm 1.68$
<b>Athletes</b>	3.66	3.54	2.59	2.26	3.94	3.82	3.05	2.71
	$\pm 0.75$	$\pm 0.89$	$\pm 0.71$	$\pm 0.71$	$\pm 1.07$	$\pm 1.11$	$\pm 0.98$	$\pm 0.78$

**Table 2:** PRO/RET ratios at both velocities on the dominant (D) and non dominant (ND) shoulders.

	PRO/RET D	PRO/RET ND	PRO/RET D	PRO/RET ND
	12.2 cm/s	12.2 cm/s	36.6 cm/s	36.6 cm/s
	(means $\pm$ SD)	(means $\pm$ SD)	(means $\pm$ SD)	(means $\pm$ SD)
<b>Sedentaries</b>	$0.81 \pm 0.17^a$	$0.81 \pm 0.16^a$	$0.68 \pm 0.14^b$	$0.87 \pm 0.23^a$
<b>Athletes</b>	$0.96 \pm 0.17^a$	$0.94 \pm 0.11^a$	$0.91 \pm 0.29^a$	$0.84 \pm 0.13^a$

<sup>a,b</sup> corresponded to significant differences,  $p < 0.05$ )

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